Brief Screening Instrument of Posttraumatic Stress Disorder for Children and Adolescents 7–15 Years of Age

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Abstract The objective of this paper is to develop a brief screening instrument of posttraumatic stress disorder (PTSD) for young victims of natural disasters. Data were derived from flood victims in 1998 and 1999 in Hunan, China. A representative population sample of 6,852 subjects 7–15 years of age was selected. Among them, 6,073 (88.6%) were interviewed. Multistage sampling was used to select the subjects and PTSD was ascertained with Diagnostic and Statistical Manual of Mental Disorders: 4th Edition (DSM-IV). We randomly assigned 80% (4,851) of the study subjects to construct the screening instrument (construct model) and the remaining 20% (1,222) subjects to examine the model (validation model). Logistic regression analysis and receiver operating characteristics curves were utilized to select a subset of symptoms and cutoff point from the pre-structured questionnaires. A seven-symptom instrument for PTSD screening was selected. Scores of 3 or more on this instrument were employed to define positive cases of PTSD with a sensitivity of 96.9%, specificity 99.0%, positive predictive value (PPV) 82.6%, and
negative predictive value (NPV) 99.8%. The brief screening instrument developed in this study is highly valid, reliable, and predictable.

**Keywords**  
Posttraumatic stress disorder · Screening instrument · Flood · Children · Adolescents · China

**Introduction**

Posttraumatic stress disorder (PTSD) is an anxiety disorder characterised by persistent reliving of the traumatic event, such as recurring or intrusive thoughts, avoidance of cues associated with the trauma or emotional numbing, and unrelenting physiological hyper-reactivity or arousal [1]. Children and adolescents are among the most vulnerable members of communities affected by disasters [2]. Symptoms of PTSD are among the most common types of psychological distress observed in children after a disaster [3–6]. The diagnosis of PTSD is made by clinical judgment preferably based on validated structured or standardized clinical interview schedules [7]. There are many PTSD diagnosis instruments now in use [8–17]. However, they are costly and time-consuming especially for large population studies. Natural disasters often happen suddenly and affect many people. In this regards, brief screening instruments for PTSD are desirable to evaluate the psychological condition of victims as soon as possible.

Although a few instruments for assessing PTSD have been developed [18–22], they are appropriate for different contexts, such as: school sniper attacks, wars, earthquakes, hurricanes, cruise-ship sinking, and industrial accidents. The psychological reaction may vary in different kinds of natural disasters. In this respect, developing a PTSD screening instrument for children and adolescent flood victims is required. A quick screening instrument for childhood PTSD is to identify populations that require an early intervention. It will be of help to clinicians, especially after disasters when a large percent of population is affected. However, the existing instruments have long contents, ranging from 22 to 54 items. To date, no short PTSD screening scale has been developed for children and adolescent flood victims. Brief screening instruments are more preferable in order to avoid burdening families, aid works, health care professional and the children themselves.

The objective of this study is to develop a brief effective screening instrument for PTSD in children and adolescents.

**Methods**

**Subjects**

In this study, the data were derived from the Hunan flood study [23]. The subjects had been directly exposed to the 1998–1999 floods in Hunan, China. A severe flood that struck China’s Hunan province in 1998 and 1999 left hundreds of thousands of residents homeless. Much of the infrastructure and many agricultural projects were damaged as well. A total of 541,216 people who lived in 2,750 km² geographic areas were flood-affected. The Hunan flood study used multistage sampling method to select subjects. A total of 8 counties, 40 towns, 310 villages, and all children and adolescents (6,852) 7–15 years of age.
of the study households (13,450) were selected. 6,073 (88.6%) of the children and adolescents 7–15 years of age were interviewed. Details of sampling and response of the Hunan flood study were described elsewhere [23]. The respondent’s consent was obtained collectively by the local Center of Disease Prevention and Control (CDC) because this study was considered as part of the disaster assistance package provided to flood victims by the local government. No individual consent was pursued.

Procedure

From January to May 2000 (8–15 months after the flood), we carried out a face-to-face interview by trained research assistants (with on site supervision by psychologists) using pre-constructed questionnaire. The selected study subjects were interviewed to ascertain PTSD. The diagnosis of PTSD was made according to the Diagnostic and Statistical Manual of Mental Disorders: 4th Edition (DSM-IV) criteria [1], which include 17 symptoms scored as 0 = none, 1 = slight, 2 = moderate, 3 = severe, and 4 = extreme. If the score equal to or greater than two the symptom was defined as positive. The 17 symptoms of PTSD were further divided into three groups, representing three diagnostic criteria: B, C, and D. Criterion B symptoms represent the re-experiencing cluster: B1, intrusive recollections; B2, repeated nightmares about floods; B3, acting as if the flood is occurring; B4, feeling worse when reminded of the flood; and B5, reactivity to flood reminders. Subjects were defined as positive if they showed one or more positive items in the B group. Criterion C symptoms make up the avoidance cluster: C1, efforts to avoid thoughts or feelings associated with the flood; C2, efforts to avoid activities that arouse recollections of the flood; C3, amnesia in regard to the flood; C4, diminished interest; C5, detachment or estrangement; C6, restricted range of affect; and C7, sense of foreshortened future. Subjects were defined as positive if they showed three or more positive items in the C group. Criterion D symptoms make up the hyper-arousal cluster: D1, difficulty falling or staying asleep; D2, irritability or anger; D3, difficulty concentrating; D4, hyper-vigilance; and D5, exaggerated startling response. Subjects were defined as positive if they showed two or more positive items in the D group. Subjects were given a diagnosis of PTSD if Criterion B, C, and D symptoms were all positive. We assessed all symptoms, including the time of the symptom occurrence and the duration of the symptom.

We took the DSM-IV PTSD criteria as ‘‘gold standard’’ to diagnose all the study subjects. Then, using the ‘select cases’ function of SPSS 11.0 for windows, we randomly assigned 80% of study subjects to construct the screening scale (construct model) and the remaining 20% sub-sample to examine the model. Conditional forward logistic regression analysis was adopted to determine the best combinations of independent variables, with or without PTSD as the dependent variable and seventeen diagnosis symptoms as independent variables. The entry threshold was set at $P = 0.05$ and the exit threshold at $P = 0.10$ for all variables. For each step forward one variable was entered and the different variable combinations obtained. We then estimated the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of different variable combinations. The optimal variable combination was determined by comparing with their sensitivity, specificity, PPV, and NPV. The best instrument was selected on the basis of a classification rule determined by the predicted probability of having PTSD. The set of fitted probabilities was evaluated in terms of sensitivity, specificity, PPV, and NPV. We stopped the stepwise procedure when the sensitivity, specificity, PPV, and NPV met the required condition, which represented the full diagnostic criteria by the fewest symptoms. We chose the best
instrument based on the predicted probability that resulted in the maximum sum of PPV and NPV. The score of instrument was based on the total number of symptoms reported by the respondents, with equal weights given to each symptom. Receiver operating characteristics (ROC) curves were used to estimate the sensitivity, specificity, PPV, NPV, and to determine the threshold values. We then used the remaining 20% subjects to examine the validity, reliability, and predictability of this screening instrument by comparing the results blindly with the PTSD diagnostic standard of DSM-IV. Kappa analysis was used to test the consistency of the results from this instrument and DSM-IV. All analyses were performed using SPSS Version 11.0 (SPSS, Chicago, IL).

Results

A total of 6,073 children and adolescents 7–15 years of age were included in our study. Among them, 3,193 were boys and 2,880 were girls. A total of 280 (4.6%) of them met DSM-IV PTSD criteria. 80% of the subjects (4,851) were randomly allocated to create the model and the remaining 20% subjects (1,222) were allocated to examine the model using the ‘select cases’ function of SPSS.

Logistic regression analysis showed that the three combinations of six-, seven-, and eight-symptom instruments at the 6, 7, and 8 steps had a high sensitivity, specificity, PPV, and NPV (Table 1). The seven-symptom instrument had the highest PPV and clinical efficiency, and the other statistics (sensitivity, specificity, and NPV) were constant across the three instruments (Table 1). Two of these symptoms were from the re-experiencing symptom cluster (B1 intrusive recollections and B2 repeated nightmares about floods), four were from the avoidance and numbing symptom cluster (C2 efforts to avoid activities that arouse recollections of the flood, C3 amnesia in regard to the flood, C4 diminished interest, and C5 detachment or estrangement), and one was from the hyper-arousal symptom cluster (D1 difficulty falling or staying asleep).

If any one item among the seven symptoms was positive, a score of 1 was assigned. The maximum accumulated score was seven. Information on the seven-symptom instrument for screening PTSD, formed by summing up the number of positive replies on the symptoms, is presented in Table 2. A total score of 3 or more appeared to be the best overall cutoff point in terms of sensitivity, specificity, clinical efficiency, PPV, and NPV. Using this score as a cutoff point for screening PTSD, we found that less than 1% of ‘true’ cases of PTSD were missed, whereas 17% of subjects without PTSD were falsely identified as having PTSD. Table 2 displays the tradeoff associated with using higher or lower cutoffs.

The ROC curve is a work curve of the screening test, which plots the true positive rate against false positive rate for the different possible cutoff points of a test. A ROC curve can reveal a series of different sensitivity and specificity values when using different cutoff points. A score of 3 or more on this instrument defined positive cases of PTSD with a

<table>
<thead>
<tr>
<th>Model</th>
<th>List of DSM-IV symptoms in model</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-symptom</td>
<td>B1, C2, C3, C4, C5, and D1</td>
<td>86.7</td>
<td>99.9</td>
<td>96.0</td>
<td>99.4</td>
</tr>
<tr>
<td>7-symptom</td>
<td>B1, B2, C2, C3, C4, C5, and D1</td>
<td>95.1</td>
<td>99.8</td>
<td>96.8</td>
<td>99.8</td>
</tr>
<tr>
<td>8-symptom</td>
<td>B1, B2, C2, C3, C4, C5, D1, and D5</td>
<td>96.0</td>
<td>99.8</td>
<td>96.1</td>
<td>99.8</td>
</tr>
</tbody>
</table>
sensitivity of 96.9%, specificity of 99.0%, clinical efficiency of 99.8%, PPV of 82.6%, and NPV of 99.8% (Table 2). The remaining 20% randomized sub-samples were measured for PTSD blindly using a score of 3 or more on this instrument and DSM-IV (Table 3). The sensitivity and specificity of the instrument was 96.3 and 99.3%, positive and negative predictive value was 86.7 and 99.8%, and clinical efficiency was 99.2%. The result of Kappa analysis showed that this instrument and DSM-IV were highly consistent on PTSD measurement ($\kappa = 0.91, u = 31.38, P < 0.01$). We performed analysis stratified by gender and age, and found no different results across different gender and age groups (data not shown).

**Discussion**

The characteristics of a good screening instrument are as follows: (a) valid and reliable; (b) concise with the minimum number of items; (c) simple to administer; (d) easy to understand; (e) time saving and cost-effective; (f) acceptable to respondents. At the same time, in order to facilitate the administration of the instrument, self-reported questionnaires are the most reliable alternative [24]. Our screening instrument appears to meet most of these criteria.

A short screening instrument is useful in surveys among disaster-affected population to select a subset of respondents who are likely to have a disorder for more intensive diagnostic assessment in the next stage [25, 26]. It can provide data for further evaluations,
treatment planning and longitudinal studies to track patterns of development of post-traumatic effects in children and adolescents. The screening instrument developed in this study was designed to quickly detect the population with high risk of PTSD in children and adolescents exposed to disaster such as floods. Sensitivity, the most important quality of a screening instrument, represents the instrument’s ability to correctly identify or “screen in” individuals with the disorder. Specificity represents the instrument’s ability to correctly identify or “screen out” individuals without the disorder. Clinical efficiency refers to the proportion of individuals who are correctly identified by the instrument [27].

Our screening instrument yielded high sensitivity, specificity, clinical efficiency, and PPV at cutoff point of three or more, for discriminating between children and adolescents with and without PTSD. These preliminary results indicated that this brief screening instrument constitutes a valid, clinically relevant, and concise measurement for PTSD. This instrument may provide clinicians and researchers with a way to further evaluate the nature and severity of the impact of a disaster.

The predictive value of a screening test is related to its sensitivity, specificity, and prevalence rate, so we should have an appreciation of the effect of prevalence rate. When the rate is low, application of Bayesian theory predicts that the target condition will not be present. At low prevalence rates, the PPV shrinks because a large number of subjects scoring positive are actually false positive. Thus, when the PTSD prevalence rate is low, the rate of identification of true cases is also low [28]. In our previous paper [23], the rate of PTSD was 4.6%, so the PPV was not high. A score of 3 on the seven-symptom screening instrument was identified as the optimal cutoff point for separating subjects with or without PTSD. This cutoff point minimized the probability of false-negative results for PTSD, at the expense of somewhat raised probability of false-positive results. This tradeoff is particularly suitable for two-phase surveys in which the first phase is designed to maximize the number of true cases of PTSD and the second phase is expected to reclassify those who were wrongly classified as having the disorder. Other uses of a screening instrument for PTSD might find another more desirable cutoff point. Clearly, this screening instrument is not a substitute for a psychiatric diagnosis [25].

Our screening instrument, Breslau’s scale [25] and Chou’s scale [29] are all seven-symptom scales, but the items included are not the same. In Breslau scale, five are from the avoidance and numbing symptom cluster, two are from the arousal symptom cluster, and none are from the re-experiencing symptom cluster [25]. In Chou’s scale, three are from the re-experiencing symptom cluster, three are from the avoidance and numbing symptom cluster, and one is from the arousal symptom cluster [29]. The threshold in our scale was the same as Chou’s 3 scores for earthquake [29] but lower than Breslau’s 4 scores for the community [25]. These results indicate that the psychological reaction varies in different types of disasters and in different populations.

Our brief self-administered 7-item screening instrument for PTSD can be completed in approximately 5 min. Using a Yes/No response format simplifies matters for respondents, whereas other measures require them to make ratings on four- or five-point scores. Furthermore, our instrument is extremely practical and useful for other health professionals, who may not be familiar with the disorder nor with the structure of PTSD symptom clusters. This instrument is convenient and useful for post-disaster assessments where time, resources and trained personnel may frequently be limited. It is also easy to be adopted by other clinical and research settings. Based on a sample of 258 patients in primary care clinical waiting areas, Kimerling tested the Breslau’s 7-item PTSD screening scale and concluded that it was time efficient and had the potential to increase the detection of...
previously unrecognized PTSD [30]. In terms of methodology, we randomly assigned 80% subjects to construct model and remaining 20% subjects to examine the model, having the same test power and effectiveness as Kimerling’s study.

Several limitations of this study should be mentioned. First, this instrument is restricted to flood victims and may not necessarily be applicable to other natural disasters. Second, data collected from a province of China may not necessarily be applicable to other populations. Third, this instrument cannot be used to indicate severity of symptoms. Despite these limitations, this instrument demonstrates good psychometric properties, which provided useful information for further PTSD evaluation.

Summary

Between January and May 2000, we conducted an epidemiologic study of 6,073 children and adolescents 7–15 years of age from 13,450 households affected by the 1998 and 1999 flood in Hunan, China. To develop a brief instrument for rapid screening of PTSD using the PTSD criteria of DSM-IV as a “gold standard”, we randomly assigned 80% (4,851) of the study subjects to construct the screening instrument and the remaining 20% (1,222) subjects to examine the model. Logistic regression analysis and receiver operating characteristics curves were utilized to select a subset of symptoms and a cutoff point from the pre-structured questionnaires. A seven-symptom instrument for PTSD screening was developed. Scores of 3 or more on this instrument were employed to define positive cases of PTSD with a sensitivity of 96.9%, specificity 99.0%, positive predictive value (PPV) 82.6%, and negative predictive value (NPV) 99.8%. Our large population-based study suggests that this screening instrument has high validity, reliability, and predictability. This screening instrument for PTSD developed in flood victims may be also useful in other disastrous events.

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